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monitoring governing factors

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Nitrification in biological rapid sand filters treating drinking water - monitoring governing factors

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Intro

Thousands of groundwater based waterworks are using biological rapid sand filters (RSF). These filters should be seen as bioreactors where microbial processes (removal of e.g. ammonia, manganese, ferrous iron, methane, sulfides and natural organic matter) are more important than the simple physical straining processes.
Unfortunately, most of the underlying microbial processes are poorly understood, which limits the management of the filters and can result in start-up problems and insufficient removal of the treated compounds.

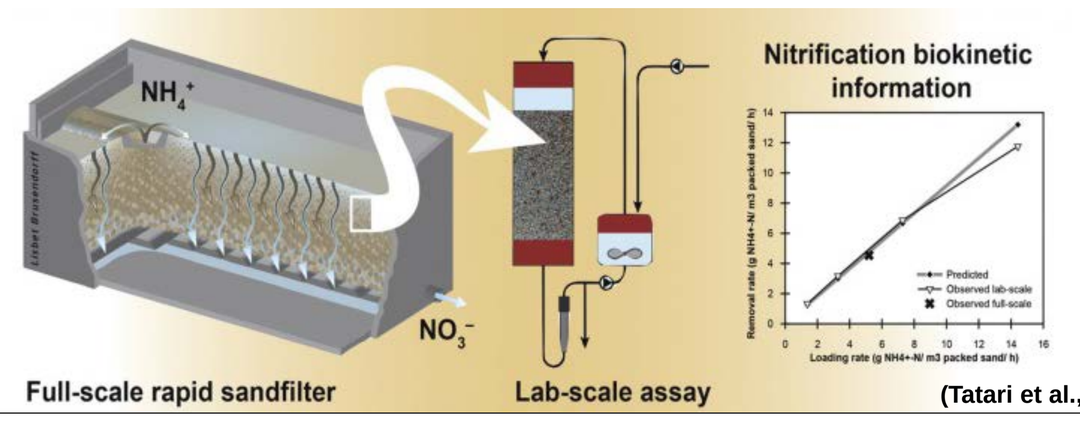
Topic & aim

To provide insight in the process mechanisms, kinetics and effects of environmental factors by:

- Molecular investigations of the microorganisms responsible for the nitrification process
- Detailed monitoring and experiments in the filters and in the laboratory

Results

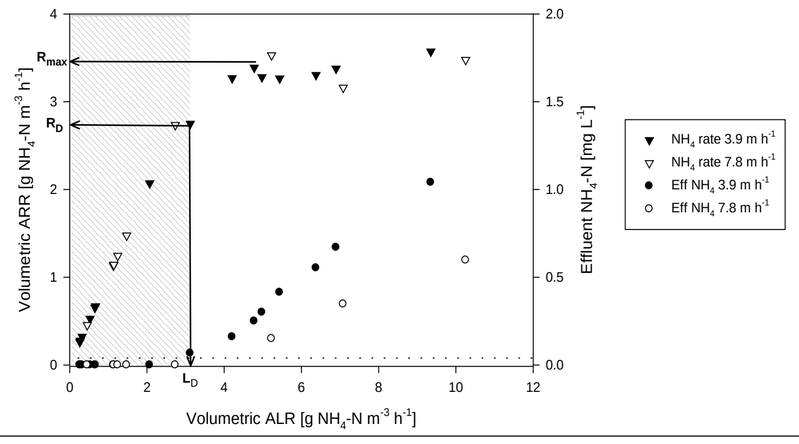
A range of tools were developed to diagnose RSF performance, including small scale column assays and depth profiling of full scale filters.
Process kinetics at different depths and locations in RSFs were mapped and quantified: several of the investigated filters were severely stratified with little activity in the lower parts. This indicates an overcapacity of the filters calling for RSF redesign.



(Tatari et al., 2013)

Results

Pilot scale columns, operated under controlled hydraulic conditions allowed to estimate safe operation windows (the shaded area) for nitrification. In this window the NH_4^+ load can be increased (by increasing flow rate or NH_4^+ concentration or both) and still meet the required effluent quality, indicating that process efficiency can be improved



(Lee et al., 2014)

Results

- Tools were also developed and implemented to elucidate the composition of the microbial communities in RSFs and to quantify specific functional groups e.g. NH_4^+ and NO_2^- oxidizers, methanotrophs and selected Fe oxidizers.
- These methods revealed the spatial distribution and density of the different functional groups, e.g.: AOA, AOB and NOB.
- Pyrosequencing of the microbiome of RSFs across several waterworks showed complex and diverse microbial communities, with a number of taxa shared across all waterworks.

References and Acknowledgements

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www.dwbiofilters.dk

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